Photometrics®
Series 300™

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57-055-001 Rev B2

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Basic Limited One (1) Year Warranty

Roper Scientific warrants this product against substantial defects in materials and / or workmanship for a period of up to one (1) year after shipment. During this period, Roper Scientific will repair the product or, at its sole option, repair or replace any defective part without charge to you. You must deliver the entire product to the Roper Scientific factory or, at our option, to a factory-authorized service center. You are responsible for the shipping costs to return the product. International customers should contact their local Roper Scientific authorized representative/distributor for repair information and assistance, or visit our technical support page at www.roperscientific.com.

Limited One (1) Year Warranty on Refurbished or Discontinued Products

Roper Scientific warrants, with the exception of the CCD imaging device (which carries NO WARRANTIES EXPRESS OR IMPLIED), this product against defects in materials or workmanship for a period of up to one (1) year after shipment. During this period, Roper Scientific will repair or replace, at its sole option, any defective parts, without charge to you. You must deliver the entire product to the Roper Scientific factory or, at our option, a factory-authorized service center. You are responsible for the shipping costs to return the product to Roper Scientific. International customers should contact their local Roper Scientific representative/distributor for repair information and assistance or visit our technical support page at www.roperscientific.com.

Normal Wear Item Disclaimer

Roper Scientific does not warrant certain items against defect due to normal wear and tear. These items include internal and external shutters, cables, and connectors. *These items carry no warranty, expressed or implied.*

VersArray (XP) Vacuum Chamber Limited Lifetime Warranty

Roper Scientific warrants that the cooling performance of the system will meet our specifications over the lifetime of the VersArray (XP) detector or Roper Scientific will, at its sole option, repair or replace any vacuum chamber components necessary to restore the cooling performance back to the original specifications at no cost to the original purchaser. *Any failure to "cool to spec" beyond our Basic (1) year limited warranty from date of shipment, due to a non-vacuum-related component failure (e.g., any components that are electrical/electronic) is NOT covered and carries NO WARRANTIES EXPRESSED OR IMPLIED.* Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Sealed Chamber Integrity Limited 24 Month Warranty

Roper Scientific warrants the sealed chamber integrity of all our products for a period of twenty-four (24) months after shipment. If, at anytime within twenty-four (24) months from the date of delivery, the detector should experience a sealed chamber failure, all parts and labor needed to restore the chamber seal will be covered by us. *Open chamber products carry NO WARRANTY TO THE CCD IMAGING DEVICE, EXPRESSED OR IMPLIED.* Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Vacuum Integrity Limited 24 Month Warranty

Roper Scientific warrants the vacuum integrity of all our products for a period of up to twenty-four (24) months from the date of shipment. We warrant that the detector head will maintain the factory-set operating temperature without the requirement for customer pumping. Should the detector experience a Vacuum Integrity failure at anytime within twenty-four (24) months from the date of delivery all parts and labor needed to restore the vacuum integrity will be covered by us. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Image Intensifier Detector Limited One Year Warranty

All image intensifier products are inherently susceptible to Phosphor and/or Photocathode burn (physical damage) when exposed to high intensity light. Roper Scientific warrants, with the exception of image intensifier products that are found to have Phosphor and/or Photocathode burn damage (which carry NO WARRANTIES EXPRESSED OR IMPLIED), all image intensifier products for a period of one (1) year after shipment. *See additional Limited One (1) year Warranty terms and conditions above, which apply to this warranty.* Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

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Roper Scientific warrants, with the exception of CCD imaging device and fiber optic assembly damage due to X-rays (which carry NO WARRANTIES EXPRESSED OR IMPLIED), all X-ray products for one (1) year after shipment. S*ee additional Basic Limited One (1) year Warranty terms and conditions above, which apply to this warranty.* Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Software Limited Warranty

Roper Scientific warrants all of our manufactured software discs to be free from substantial defects in materials and / or workmanship under normal use for a period of one (1) year from shipment. Roper Scientific does not warrant that the function of the software will meet your requirements or that operation will be uninterrupted or error free. You assume responsibility for selecting the software to achieve your intended results and for the use and results obtained from the software. In addition, during the one (1) year limited warranty. The original purchaser is entitled to receive free version upgrades. Version upgrades supplied free of charge will be in the form of a download from the Internet. Those customers who do not have access to the Internet may obtain the version upgrades on a CD-ROM from our factory for an incidental shipping and handling charge. *See Item 12 in the following section of this warranty ("Your Responsibility") for more information.*

Owner's Manual and Troubleshooting

You should read the owner's manual thoroughly before operating this product. In the unlikely event that you should encounter difficulty operating this product, the owner's manual should be consulted before contacting the Roper Scientific technical support staff or authorized service representative for assistance. If you have consulted the owner's manual and the problem still persists, please contact the Roper Scientific technical support staff or our authorized service representative. *See Item 12 in the following section of this warranty ("Your Responsibility") for more information.*

Your Responsibility

The above Limited Warranties are subject to the following terms and conditions:

1. You must retain your bill of sale (invoice) and present it upon request for service and repairs or provide other proof of purchase satisfactory to Roper Scientific.
2. You must notify the Roper Scientific factory service center within (30) days after you have taken delivery of a product or part that you believe to be defective. With the exception of customers who claim a "technical issue" with the operation of the product or part, all invoices must be paid in full in accordance with the terms of sale. Failure to pay invoices when due may result in the interruption and/or cancellation of your one (1) year limited warranty and/or any other warranty, expressed or implied.
3. All warranty service must be made by the Roper Scientific factory or, at our option, an authorized service center.
4. Before products or parts can be returned for service you must contact the Roper Scientific factory and receive a return authorization number (RMA). Products or parts returned for service without a return authorization evidenced by an RMA will be sent back freight collect.
5. These warranties are effective only if purchased from the Roper Scientific factory or one of our authorized manufacturer's representatives or distributors.

6. Unless specified in the original purchase agreement, Roper Scientific is not responsible for installation, setup, or disassembly at the customer's location.
7. Warranties extend only to defects in materials or workmanship as limited above and do not extend to any product or part which has:
    - been lost or discarded by you;
    - been damaged as a result of misuse, improper installation, faulty or inadequate maintenance or failure to follow instructions furnished by us;
    - had serial numbers removed, altered, defaced, or rendered illegible;
    - been subjected to improper or unauthorized repair; or
    - been damaged due to fire, flood, radiation, or other "acts of God" or other contingencies beyond the control of Roper Scientific.
8. After the warranty period has expired, you may contact the Roper Scientific factory or a Roper Scientific-authorized representative for repair information and/or extended warranty plans.
9. Physically damaged units or units that have been modified are not acceptable for repair in or out of warranty and will be returned as received.
10. All warranties implied by state law or non-U.S. laws, including the implied warranties of merchantability and fitness for a particular purpose, are expressly limited to the duration of the limited warranties set forth above. With the exception of any warranties implied by state law or non-U.S. laws, as hereby limited, the forgoing warranty is exclusive and in lieu of all other warranties, guarantees, agreements, and similar obligations of manufacturer or seller with respect to the repair or replacement of any parts. In no event shall Roper Scientific's liability exceed the cost of the repair or replacement of the defective product or part.
11. This limited warranty gives you specific legal rights and you may also have other rights that may vary from state to state and from country to country. Some states and countries do not allow limitations on how long an implied warranty lasts, when an action may be brought, or the exclusion or limitation of incidental or consequential damages, so the above provisions may not apply to you.
12. When contacting us for technical support or service assistance, please refer to the Roper Scientific factory of purchase, contact your authorized Roper Scientific representative or reseller, or visit our technical support page at www.roperscientific.com.

Declaration of Conformity

Roper Scientific, Inc. declares that the equipment described in this document is in conformance with the requirements of the European Council Directives, listed below:

89/336/EEC	EMC Directive
93/68/EEC	EMC Directive
73/23/EEC	Low Voltage Directive

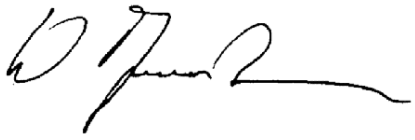
on the approximation of the laws of Member States relating to Electromagnetic Compatibility and Product Safety.

This declaration is based upon compliance of the product to the following standards:

EN 55022:1994	RF Emissions Control
EN 50082-1:1992	Immunity to Electromagnetic Disturbances
EN 60950	Product Safety

Product Description: CCD Camera System
Models: Series 300 Camera System
(CE300, CH350, CH360, CH370)

Authorized Signature Date 1/24/97



Wilhelm Pfanhauser, Managing Director

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CE

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Chapter 1. Introduction

The Photometrics™ Series 300™ is an F-mount or C-mount, air- or liquid-cooled imaging system for acquiring digital scientific data. When the highest dynamic range is required, the Series 300 is the lowest noise, most sensitive camera system in the Photometrics line.

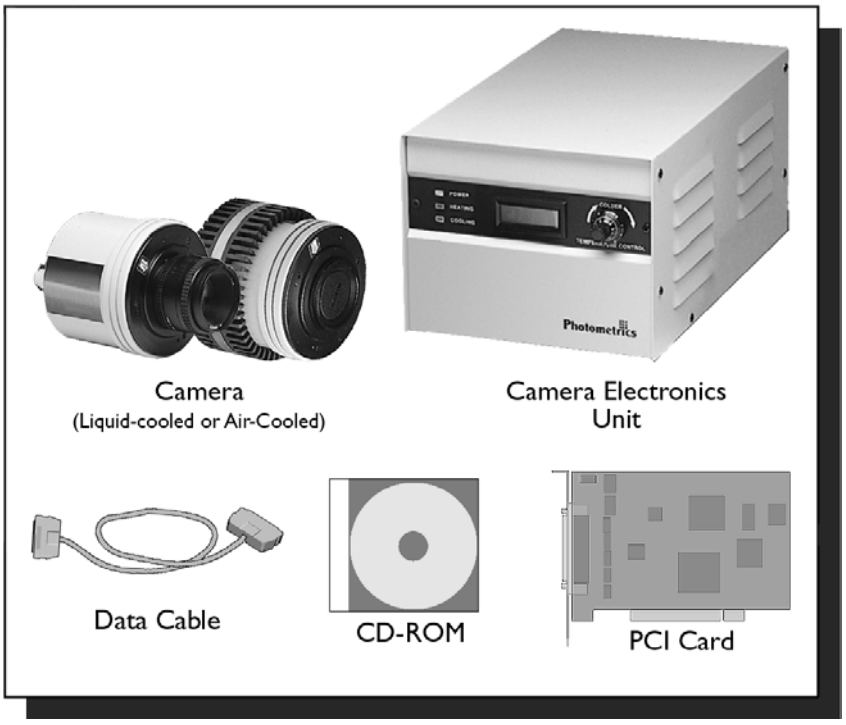
Series 300 System Components

All Series 300 systems consist of standard hardware and software as well as the appropriate interface hardware (discussed in the *Installation Guide*) for your computer system. Some Series 300 systems also include optional hardware.

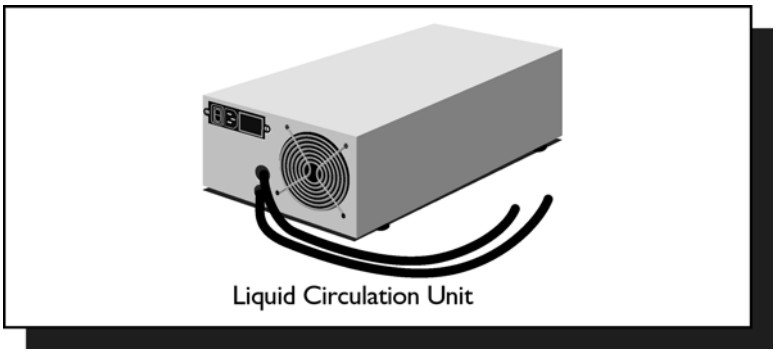
Standard Components

Components for the Series 300 camera system are listed as follows:

- Camera electronics unit (CEU)
- Camera head (CH)
- Liquid circulation unit (LCU, optional: for use with a liquid-cooled camera head)
- Data cable (connects CEU and PCI card)
- Camera head cable (connects camera head and CEU)
- PCI card
- CD-ROM



Optional System Hardware



About this Manual

The *Series 300 User Manual* is divided into seven chapters. It is suggested that you read the entire manual before operating the camera to ensure proper usage. The chapters that follow this introduction are:

- **System Installation —** Instructions for installing the camera system's hardware.
- **CEU and Camera Heads —** Instructions for operating and maintaining the hardware
- **LCU Maintenance —** Instructions for maintaining the liquid circulation unit
- **Component Descriptions —** Functional description of each camera system component
- **Troubleshooting —** Answers to camera hardware problems
- **Specifications —** Specifications for each camera system component

Note: To install a new camera, follow the instructions in the *System Installation* chapter of this *User Manual.*

Environmental Requirements

The Series 300 camera system and its optional liquid circulation unit should be operated in a clean, dry environment. The camera system requires that an easily accessible electrical outlet be available near the equipment.

The camera system's ambient operating temperature is 0°C to 40°C with a relative humidity of 0%–80% noncondensing.

Storage Requirements

Store the Series 300 camera system and the LCU in their original containers. To protect the system from excessive heat, cold, and moisture, store at an ambient temperature between -20°C and 50°C with a relative humidity of 0%–90% noncondensing.

Precautions

The charge-coupled device (CCD) and other system electronics are extremely sensitive to electrostatic discharge (ESD) and the optional liquid circulation unit requires periodic maintenance.

CEU and Camera

To avoid permanently damaging the system, please observe the following precautions:

- If you are using high-voltage equipment (such as an arc lamp) with your camera system, be sure to turn the camera power on last and power the camera off first.
- If you have a liquid-cooled camera head, you MUST operate the LCU whenever the camera is on.
- Use caution when triggering high-current switching devices (such as an arc lamp) near your system. The CCD can be permanently damaged by transient voltage spikes. If electrically noisy devices are present, an isolated, conditioned power line or dedicated isolation transformer is highly recommended.
- Never connect or disconnect any cable while the camera system is powered on. An unconnected cable segment can become electrically charged and can damage the CCD if reconnected.
- Always install the shorting plug on the camera head when the head is disconnected from its cable.
- Do not connect the camera head cable to the camera head until the cable is first connected to the camera electronics unit (CEU).
- Do not disconnect the camera head cable from the CEU until the cable is first disconnected from the camera head.
- The system has been configured for 100V, 110V, 220V, or 240V AC input at 50/60 Hz. Do not connect your Series 300 system to a power source for which it was not configured or to a power source that has less than 1 kVA capacity.
- Never impede airflow through the equipment by obstructing the air vents. Allow at least one inch air space around any vent.
- Do not "mix and match" camera heads and CEUs. Refer to the Certificate of Performance supplied with your system for the serial numbers of the camera head and the electronics unit for this system.

Optional LCU

To prevent damage to the LCU:

- Keep the seals lubricated by running the LCU 45 minutes at least once a month.
- Always keep the pump primed by operating LCU in the upright position.
- When disconnecting the coolant hoses from the camera, it is important to prevent any coolant from spilling into the camera. When disconnecting the hoses, hold the camera over an absorbent material, such as paper towels, with the connectors facing down.
- Never impede airflow through the LCU by obstructing the air vents.

Repairs

Other than repairs described in this manual, all repairs must be done by Roper Scientific. Should your system hardware need repair, contact Roper Scientific Customer Service. Please save the original packing materials so you can safely ship the camera system to another location or return it for repairs if necessary.

Cleaning

Clean exterior surfaces of the camera system with a dry, lint-free cloth. To remove stains, contact Roper Scientific Customer Service.

Roper Scientific Customer Service

If you have any questions about your camera system, contact Roper Scientific Customer Service. When you call, please have your Roper Scientific job number or equipment serial numbers available.

- Phone: 800.874.9789/520.889.9933 between 8:00 a.m. and 5 p.m. MST
- Fax: 520.295.0299
- E-mail: cservice@roperscientific.com
- Mail: Roper Scientific
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  Tucson, Arizona 85706

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  Mihama-ku, Chiba-shi
  Japan 261-8501

General product information and answers to some customer service questions can be found on our website: http://www.roperscientific.com

Chapter 2. System Installation

Carefully review the *Precautions* section on page 3 before performing any of the procedures outlined here. Again, use only a Series 300 cable and a Series 300 PCI card with your Series 300 camera. Using a different cable or PCI card may result in permanent damage to your system.

Introduction

Your Series 300 camera system has the following hardware components:

- Camera Head (CH)
- Camera Electronics Unit (CEU)
- Camera Head Cable
- PCI Card
- Data Cable
- Optional Liquid Circulation Unit (LCU)

Series 300 system components are linked by custom cables and controlled by your host computer system. All of the components and cables required for your configuration should be included with your shipment. Refer to the information and figure in *Series 300 System Components* on page 1.

Your Series 300 camera system has been specially configured to match the detector and readout rate options specified at the time of purchase. The CCD you selected is installed in your camera head, and the analog processor card option you selected is installed in your CEU.

Keep all the original packing materials so you can safely ship the Series 300 system to another location or return it for service if necessary.

If you have any difficulty with any step of the instructions, call Roper Scientific Customer Service.

Software Compatibility Requirements

The Series 300 package includes the RS Image™ capture software program designed for use with your Series 300 camera.

All other imaging software must also be PVCAM® -compatible. For full access to imaging software functions, PVCAM must be version 2.6.1 or higher.

Host Computer Requirements

The host computer for your Series 300 camera must have the following:

- Windows® 98SE, Windows® ME, Windows NT®, Windows® XP, or Windows® 2000 operating system
- 200 MHz Pentium® II (or greater)
- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- 16-bit color display (or greater)

**To store images to a local hard disk, up to 8 MB of free disk space is needed per file.*

If you are a Mac® user, the host computer for your Series 300 camera must have the following:

- Macintosh® OS 8.X, OS 9.X, or OSX
- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- Video adapter that supports 24-bit color (millions of colors)

**To store images to a local hard disk, up to 8 MB of free disk space is needed per file.*

Multiple Cameras

PVCAM supports multiple open cameras. In order to use this function, your imaging software must also support it. The RS Image capture software program included with your system supports multiple cameras, as do many other imaging packages.

If your imaging software supports multiple cameras, there must be a separate PCI card for each camera. Multiple cameras can only be open simultaneously if all use PCI interfaces.

Cables and Connectors

In addition to the AC power cord, the Series 300 camera system uses the following cables:

- Data cable, connects the CEU and the host interface hardware shipped with your system
- Camera head cable, with DB37 connectors on both ends.

For more information, see *Connectors* on page 25.

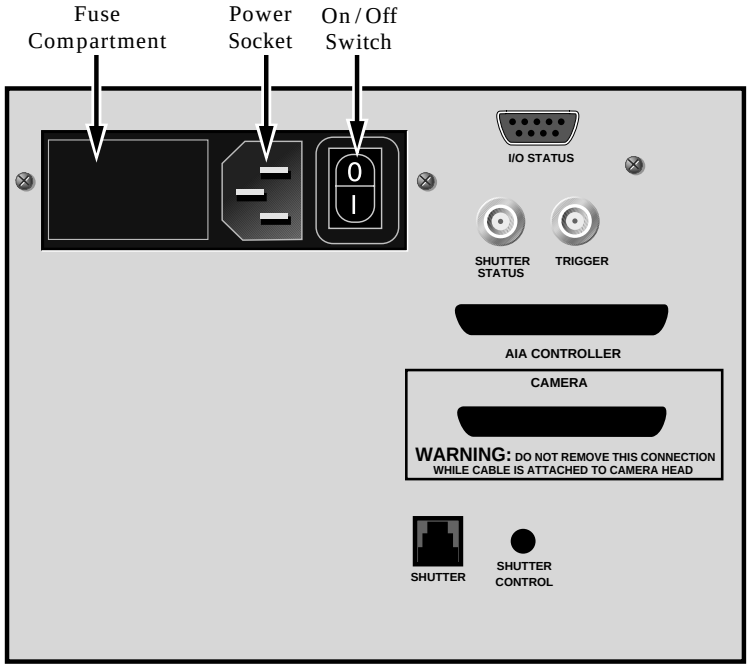
Connecting the Data Cable

Note: Before proceeding, make sure the CEU is powered off (Off = 0) and unplugged.

If your system's Data cable has a wide end and a narrow end, connect the wide end of the cable to the CEU's AIA Controller connector (see the diagram on the next page). If your system's Data cable has matching ends, connect either end of the data cable to the CEU's AIA Controller connector.

Make sure to use the Data cable that was shipped with your system. You will be connecting the other end of the Data cable to your interface hardware. For the moment, simply leave the other end of the Data cable unattached.

CEU Back Panel



Installing Camera Electronics Unit

To install the camera electronics unit (CEU):

1. With the computer and CEU powered off (Off = 0 on the CEU), ensure that the Data cable is properly attached to the CEU.
2. Connect the AC power cord to the CEU (and later to an AC power source). If possible, use a surge suppressor or uninterruptable power supply to protect your equipment. Check that all connections are secure.

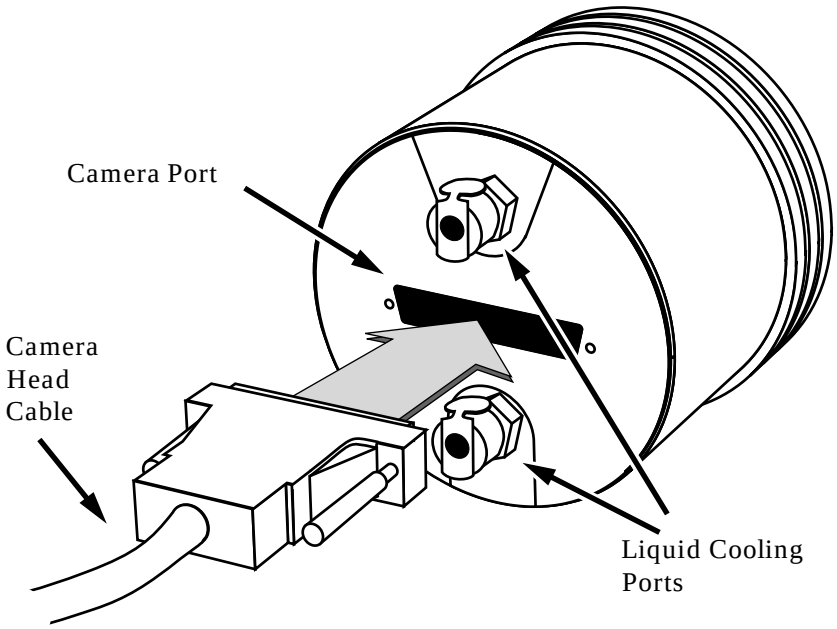
Installing CCD Camera Heads

Caution: Opening your Series 300 camera head voids the camera warranty.

Installing CH350/L CCD Camera Head

This liquid-cooled camera head uses liquid circulation to draw heat away from the thermoelectric cooler.

Installing the CH350/ L Camera



Install the camera head cable as follows:

1. With the CEU powered off, plug the cable end labeled CONNECT TO CEU into the camera port on the back panel of the CEU.
2. Remove the shorting plug from the camera port on the camera head and save it. (Always re-insert the shorting plug into this camera port when the camera head cable is disconnected. The plug prevents static electricity damage to the CCD.)
3. Plug the cable end labeled CONNECT TO CAMERA HEAD into the camera port on the camera head.

Caution: This camera head must be used with a liquid circulation unit (LCU). To install the LCU, see Connecting the Liquid Circulation Unit on page 9. Never operate the camera without the LCU connected and operating properly.

The SERIAL REGISTER arrow on the camera head indicates the location of the serial register for the output node of the CCD. The position of the register varies, depending on the type of CCD.

Connecting the Liquid Circulation Unit

The liquid-cooled camera *must always* be operated with the LCU or another acceptable liquid circulator. (To install a different liquid circulator, remove the two quick disconnects on the rear of the camera head if necessary and replace them with male 1/8″ NPT fittings that connect to your liquid circulating system. Contact Roper Scientific Customer Service for further assistance.)

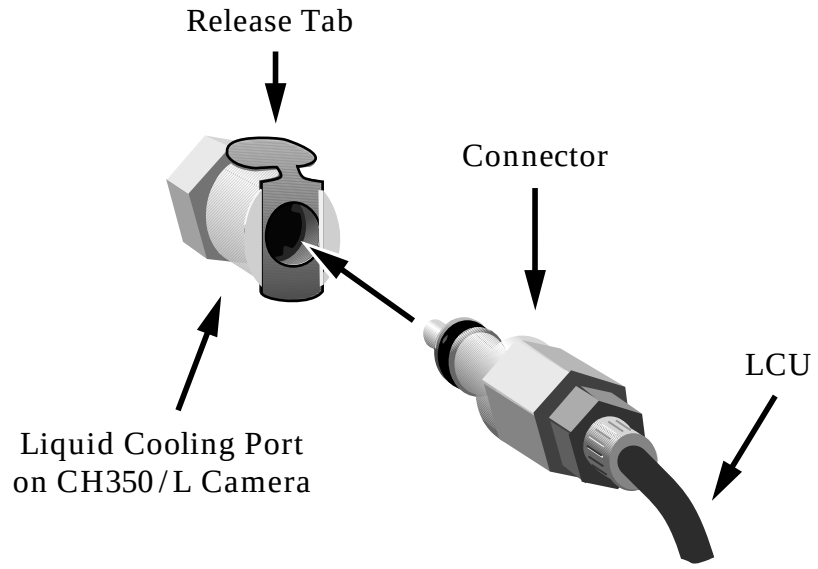
In order to operate properly, the reservoir in the LCU must be at least 3/4 full:

- If you are installing a newly shipped LCU, the reservoir is filled with the proper amount of coolant. Follow connection instructions below.
- If you are not installing a newly shipped LCU, see *Refilling the Reservoir* on page 19 in order to check the coolant level in the reservoir before connecting the LCU to the liquid-cooled camera head.

To connect the LCU:

With the power switch in the *off* position (0), connect the LCU hoses:

Attaching the Coolant



1. On the camera head, press the release tab on the liquid cooling port.
2. Holding the release tab down, insert the connector on the LCU hose into the liquid cooling port.
3. Release the release tab.

   When both hoses are attached, connect the power cord to the LCU (and later to an electrical outlet).

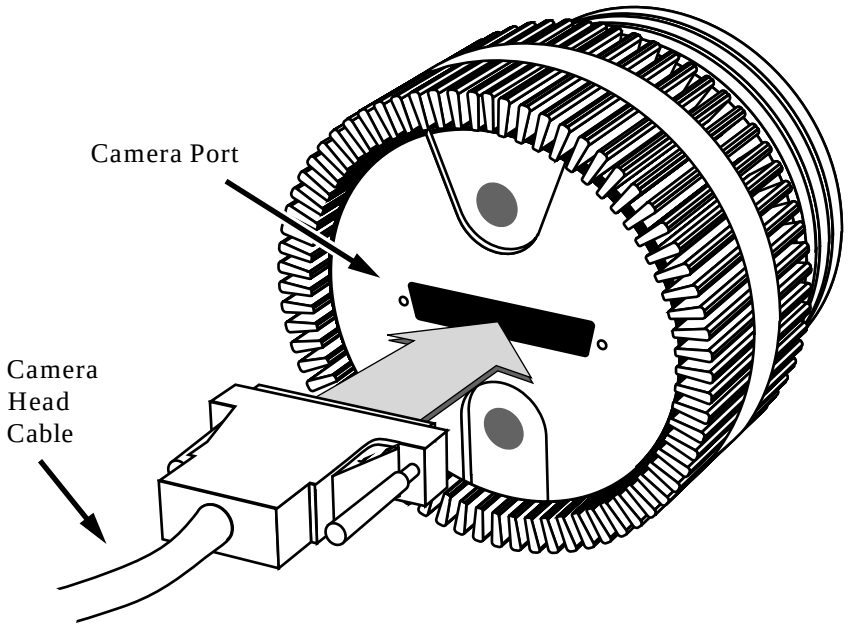
Caution: Do not allow the reservoir to drain below half full. To keep the pump primed, always operate the LCU in the upright position.

When disconnecting the LCU from the camera, it is important to keep any coolant from spilling into the camera. Make sure to see *Disconnecting the Coolant Connectors* on page 19 for instructions on disconnecting the LCU.

Installing CH350/A CCD Camera Head

This air-cooled camera head uses passive air circulation to draw heat away from the thermoelectric cooler.

Installing the CH350/A Camera



Install the camera head cable as follows:

1. With the CEU powered off, plug the cable end labeled CONNECT TO CEU into the camera port on the back of the CEU.
2. Remove the shorting plug from the camera port on the camera head and save it. (Always re-insert the shorting plug into this camera port when the camera head cable is disconnected. The plug prevents static electricity damage to the CCD.)
3. Plug the cable end labeled CONNECT TO CAMERA HEAD into the camera port on the camera head.

Caution: Never impede airflow through the equipment by obstructing the air vents. Allow at least one inch air space around any vent.

The SERIAL REGISTER arrow on the camera head indicates the location of the serial register for the output node of the CCD. The position of the register varies, depending on the type of CCD.

Installing the PCI Card

To Install the PCI Card:

1. Shut down the computer.
2. Insert the PCI card into an unused slot in your computer. Be sure to secure the PCI card to the computer case with a screw or other fastener.
3. Connect the Data cable to the PCI card.

Installing the Software

This section briefly describes the files on the CD-ROM shipped with your Series 300 system and then steps you through the installation of the PVCAM library and RS Image on your computer. The PVCAM library is a collection of functions for camera control and data acquisition that is an interface between the camera and an imaging application software package. RS Image is a basic imaging software package, developed by Roper Scientific, that interacts with the Series 300 camera through the PVCAM library.

The files provided on the CD-ROM include:

- **Readme text files —** these files contain the latest information on the software installations and should be read before you run the PVCAMSetup program.
- **PVCAMSetup software program —** this software installs the camera interface software.
- **RSImageSetup software program —** this software installs the RS Image application program.
- **MacOS directory —** this directory contains the files required for installing on a Macintosh computer.
- **Acrobat directory —** this directory contains subdirectories containing installation programs for Acrobat® Reader®.
- **Manuals directory —** this directory contains user manuals in PDF format.

Using the instructions below, install the PVCAM and RS Image software on your computer. Follow the instructions for your computer operating system: Windows or Macintosh.

Windows Users

To Install the Camera-Interface Software (PVCAM):

1. Turn on your PC and insert the supplied CD-ROM. Windows NT® users must log on as Administrator.
2. Click on the Windows Start button. Then click on "Run" and type **f:\PvcamSetup.exe** and click on **OK**.

   Note: The drive letter for the CD drive is assumed to be F. If F is not correct for your CD drive, use the appropriate drive letter.

3. Complete the automated software-installation sequence. When prompted during installation, choose "Standard" (recommended) or "Custom" install. When prompted by the Setup Complete dialog box, select the "No, I will restart the computer later" choice.

To Install the Application Software (RS Image):

1. Click on the Windows Start button. Then click on "Run" and type **f:\RSImageSetup.exe** and click on **OK**.

   Note: The drive letter for the CD drive is assumed to be F. If F is not correct for your CD drive, use the appropriate drive letter.

2. Complete the automated software-installation sequence.
3. Reboot your computer.

Macintosh Users

To Install the Camera-Interface (PVCAM) and the Application (RS Image) Software:

1. Turn on your Macintosh computer.
2. Open the appropriate folder for your version of Mac OS.
3. Copy the RSImage application icon to your hard drive.
4. Copy the DDILib, PhotometricsPCI, and Power PVCAM icons to the System folder.
5. When a dialog box appears and indicates that the three icons placed in the System folder will be automatically moved to the Extensions folder, click on OK. If this dialog box does not appear, move the icons (copied in Step 4) to the Extensions folder.
6. Restart your computer.

Connecting to Other Equipment

Series 300 camera heads have either a C- or F-mount configuration. The C-mount configuration is a standard threaded video mount with a standard C-mount flange focal distance. The F-mount configuration has a Nikon® bayonet mount with a standard F-mount flange focal distance.

Lenses

With the F-mount camera, you can install any lens that is compatible with a standard Nikon bayonet mount. With the C-mount camera, you can install any lens that is compatible with a standard threaded video mount as long as the objective does not extend farther than .27 inches behind the flange of the lens. A C-mount lens with optics that protrude a long distance into the camera may interfere with the shutter blades. For specifications on calculating acceptable flange focal distances, see *C-Mount CH350/L CCD Camera Head* on page 36 or *C-Mount CH350/A CCD Camera Head* on page 38. Photometrics offers compatible C- and F-mount lenses.

To install a lens, remove the camera aperture cover. Insert the lens into the lens mount. C-mount lenses screw in. F-mount lenses should be turned until they lock in place.

Scientific Instruments

An F-mount camera can be mounted to any instrument that is compatible with a standard Nikon bayonet mount. A C-mount camera can be mounted to any instrument that is compatible with a standard threaded video mount. If you need to adjust your Series 300 focal distance for parfocal adjustment, use standard optical shims. (Shims are precision washers that are placed over the threading of the C-mount of the instrument in order to increase the distance between the CCD plane and the instrument.) If your instrument requires a mount adapter, contact your instrument supplier.

Trigger Equipment

You can connect the camera to trigger equipment through the I/O Status, Trigger, or Shutter Status connectors located on the back panel of the CEU. For connector descriptions, see *Connectors* on page 25. Connector pin-out specifications begin on page 41.

Status Lights

The CEU and LCU power switches are on their back panels (On=|, Off=0).

- The yellow POWER light on the CEU's front panel indicates AC power.
- The green COOLING light glows to show that CCD cooling has begun. When the CCD temperature is several degrees above the regulated temperature, the COOLING light dims. It goes out when the final temperature is reached (approximately 15 minutes for a thermoelectrically cooled camera head). If the COOLING light does not go out, refer to the appropriate guidelines found in the section of *Chapter 3. CEU and Camera Heads* that deals with your particular camera head.
- The red HEATING light illuminates dimly after the regulated temperature is reached, indicating that heater current is being applied to maintain the proper temperature.

If you have a problem, refer to *Camera System Startup Problems* on page 28.

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Chapter 3 CEU and Camera Heads

CEU

The camera electronics unit contains signal processing, camera control, and temperature control systems. It produces CCD clocking signals for the camera head and manages the transfer of raw CCD data to the host interface hardware.

The internal components of the CEU include a quadruple-voltage power supply, a temperature controller, an electronics card cage, and a fan.

Note: None of the internal components of the CEU are user serviceable.

Operational Requirements

Ambient temperature: from 0°C to 40°C

Relative humidity: from 0% to 80%, noncondensing

Storage Requirements

Ambient temperature: from -20°C to 50°C

Relative humidity: from 0% to 90%, noncondensing

Power

Power for the CEU is provided by an AC power cord plugged into the power socket on the back panel. The CEU is configured for 100V, 110V, 220V, or 240V at 50/60 Hz. The voltage is shown on the electrical requirements label on the back panel.

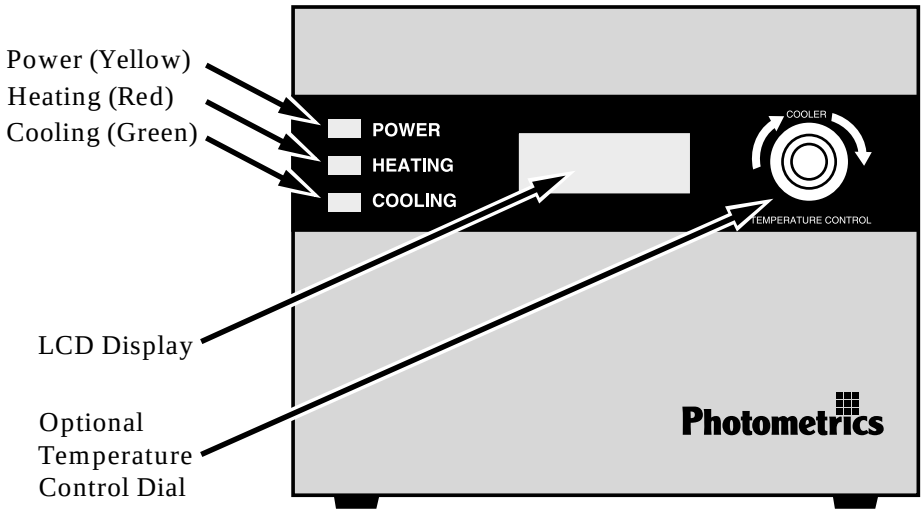
Caution: The CCD in your camera head can be permanently damaged by transient voltage spikes. Use caution when triggering high-current switching devices (such as an arc lamp) near your system. If electrically noisy devices are present, an isolated, conditioned power line or dedicated isolation transformer is highly recommended. If you are using high-voltage equipment with your camera system, be sure to turn the camera power *on last* and power the camera *off first.*

When the on/off switch on the back panel of the CEU is off, all internal DC voltages are interrupted. This turns off both the CEU and the CCD camera head, allowing maintenance when the host computer is still powered up.

Front Panel

The figure below illustrates the front panel of the CEU. If you selected the optional CEU with temperature control, there is an additional dial on the front panel (shown in graphic below) to the right of the LCD Display.

CEU Front Panel
(for Thermoelectrically Cooled Camera Heads)



- The yellow POWER light glows when the CEU is plugged in and turned on. It indicates that AC power is present.
- The green COOLING light glows when CCD cooling begins. When the CCD temperature is several degrees above the regulated temperature, the COOLING light dims. It goes out when the final temperature is reached (approximately 15 minutes for thermoelectrically cooled camera heads).
- The red HEATING light illuminates dimly after the regulated temperature is reached, indicating that heater current is being applied to maintain proper temperature.
- The LCD shows the current temperature of the CCD (within 2° C).

The CEU back panel is standard and appears on page 7. The connectors located on the back panel are discussed in *Connectors* on page 25. For instructions on changing a fuse, see *Changing a Fuse in the CEU* on page 33.

Camera Heads

Photometrics CCD camera heads are cooled to reduce dark current, the spontaneous charge generated by heat and other non-photon sources. Cooling is achieved by a thermoelectric (Peltier) cooler (with optional liquid-assist). All Photometrics Series 300 camera heads are composed of a sealed CCD enclosure, a shutter assembly, and a lens. The sections that follow discuss the operation and maintenance of each Series 300 camera head.

Caution: Opening the Series 300 camera head voids the camera warranty.

CH350/L CCD Camera Head

The camera head requires liquid circulation to draw heat away from the thermoelectric cooler. Photometrics offers a liquid circulation unit (LCU) for this purpose. For information about connecting the LCU to the liquid-cooled camera head, see *Connecting the Liquid Circulation Unit* on page 9. LCU operation and maintenance are addressed in *Chapter 4*.

Liquid Cooling

The CCD in the camera head is cooled by a three-stage thermoelectric cooler. During normal operation, the cooler generates heat, which is removed by liquid circulating through the heat exchanger. The heat exchanger is maintained at approximately the same temperature as the liquid coolant.

Caution: Never operate the camera without the LCU connected and operating properly.

If the COOLING light on the CEU is still on after 15 minutes of continuous operation, check your camera head. The front lens mount should be warm to the touch, not hot.

If the camera head is hot, see *CH350/L Not Cooling* on page 29. If the front lens mount is warm and there are no apparent problems with the LCU (again, see *CH350/L Not Cooling* on page 29), but the COOLING light remains on, there may be a problem with the thermoelectric cooler or a loss of vacuum in the camera head.

Operational Requirements

Ambient temperature: from 0°C to 40°C

Relative humidity: from 0% to 80%, noncondensing

Storage Requirements

Ambient temperature: from -20°C to 50°C

Relative humidity: from 0% to 90%, noncondensing

CH350/A CCD Camera Head

The camera head incorporates an air-cooled heat exchanger to draw heat away from the thermoelectric cooler.

Air Cooling

The CCD in the camera head is cooled by a thermoelectric cooler. During normal operation, the cooler generates heat, which is removed by the finned heat sink. The temperature of the heat sink may rise to 40°C. It is normal for the entire camera body to heat up slightly during operation.

Caution: Never impede airflow around the finned heat sink assembly. If airflow around the camera is cut off, permanent damage to the thermoelectric cooler results. A fan can be used to circulate air if the camera head must be operated in a confined location.

If the COOLING light on the CEU is still on after 15 minutes of continuous operation, check your camera head. The cooling fins should be warm to the touch, not hot.

If they are hot, check that the fins are not blocked from surrounding air flow and that ambient temperature does not exceed 24°C. If these conditions are met, there may be a problem with the thermoelectric cooler or vacuum chamber.

Operational Requirements

Ambient temperature: from 0°C to 40°C (at an ambient temperature above 27°C, the CCD may not reach its lowest specified temperature)

Relative humidity: from 0% to 80%, noncondensing

Storage Requirements

Ambient temperature: from -20°C to 50°C

Relative humidity: from 0% to 90%, noncondensing

Chapter 4 LCU Maintenance

The liquid-cooled Series 300 camera head *must always* be operated with the liquid circulation unit (LCU) connected and operating properly.

LCU Precautions

To prevent damage to the LCU please observe the following precautions:

- Keep the seals lubricated by running the LCU for 45 minutes at least once a month.
- Always keep the pump primed by operating the LCU in the upright position.
- When disconnecting the coolant hoses from the camera, it is important to prevent any coolant from spilling into the camera. When disconnecting the hoses, hold the camera over an absorbent material, such as paper towels, with the connectors facing down.
- Never impede airflow through the LCU by obstructing the air vents.

Disconnecting the Coolant Connectors

To disconnect the coolant hoses:

Caution: When disconnecting the coolant hoses, excess coolant will spill from the hoses and connectors. It is important to keep any coolant from spilling into the camera.

1. Turn off the LCU power (Off = 0).
2. To keep excess coolant from spilling into the camera, position the camera over absorbent material with the coolant connectors facing down.
3. Press the connector release tabs and disconnect the hoses from the camera.

Refilling the Reservoir

Check the reservoir every three months to see if coolant needs to be added to the system. (To check the reservoir level, remove the cover as shown on the next page.)

WARNING: Use only the fluorescent pink coolant mixture supplied by Roper Scientific (part number 24-071-001), which is a mixture of DOWTHERM SR-1 and de-ionized water. Use of any other coolant mixture may lead to instrument failure. Do not combine mixtures (see Compatibility with Traditional Ethylene Glycol in Appendix A in the Liquid Circulation Unit manual (57-058-001) for more information).

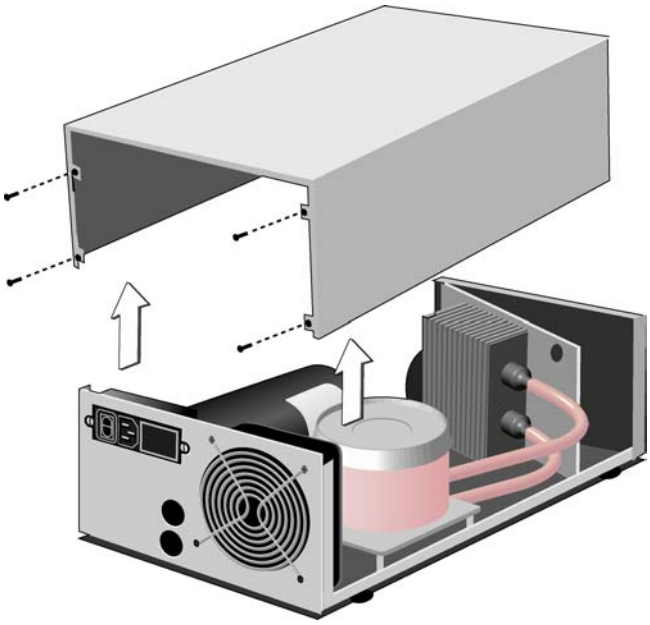
Add coolant if the reservoir is less than 3/4 full.

- Required coolant mixture: mixture of DOWTHERM SR-1 and de-ionized water (mixture supplied by Roper Scientific)
- Liquid coolant capacity: 27 fluid ounces (800 cc)

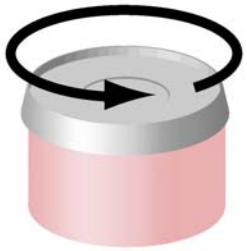
Caution: Do not allow the reservoir to drain below 1/2 full.

To refill the LCU:

1. Turn off the LCU power (Off = 0), and disconnect the power cord.
2. Remove the four screws on the back panel of the LCU. Remove cover.



3. Remove the cap from the coolant reservoir.



4. Fill the reservoir to approximately 1/4″ from the top with the coolant mixture supplied by Roper Scientific.

WARNING: Use only the fluorescent pink coolant mixture supplied by Roper Scientific (part number 24-071-001), which is a mixture of DOWTHERM SR-1 and de-ionized water. Use of any other coolant mixture may lead to instrument failure. Do not combine mixtures (see Compatibility with Traditional Ethylene Glycol in Appendix A in the Liquid Circulation Unit manual (57-058-001) for more information).

5. Replace the reservoir cap, LCU cover, and screws.
6. Reconnect the power cord.

Removing Air Bubbles

Normally, air bubbles that have formed in the tubing due to low coolant level will work their way out after the reservoir is filled. However, if the fluid level in the reservoir has become exceptionally low or if the LCU was operated on a slanted surface, bubbles may remain in the tubing even after refilling the reservoir. In order to clear these bubbles, it may be necessary to watch the coolant flow through the tubing inside the LCU.

- First fill the reservoir to the proper level and then reinstall the cover securely on the reservoir.
- With the LCU connected to a camera head and turned on, look for any tube inside the LCU that is not completely filled with coolant.

  WARNING: Use extreme caution while working inside an operating LCU. There is a cooling fan that could cause physical injury, and voltages up to 240V, which could cause electrical shock.

- If you find a tube with air in it, lift the LCU and tilt and rotate it so the air bubble works its way back to the reservoir inlet. The goal is to have the LCU pump air bubbles back into the reservoir. Air always moves up in relation to fluids, so you should tilt and rotate the LCU so air bubbles can move up through the liquid. The air bubbles may have to travel all the way through the tubing and the camera head on their way back to the reservoir.
- Keep in mind that the reservoir outlet is at the bottom of the reservoir. Be sure the reservoir outlet is completely submerged at all times. If you tilt the LCU so the reservoir outlet is higher than the fluid level, the pump will introduce more air into the tubing.

Coolant will eventually displace all air bubbles in the tubing. Once the bubbles have been worked out of the tubing, the reservoir may need to be filled since coolant formerly in the reservoir is now in the tubing in place of the air bubbles.

Attaching the Coolant Connectors

See *Connecting the Liquid Circulation Unit* on page 9.

Changing Line Entry Module Fuses and Voltages

The voltage selector card and fuse configuration on the AC line entry module is set to the correct voltage for your country. If your voltage needs to be changed, you will need to change the voltage selector card, and you may need to change the fuse configuration. To change the voltage and the fuse configuration see *Changing LCU Line Entry Module Fuses and Voltages* on page 31.

Operational Requirements

Ambient temperature: from 0°C to 40°C

Relative humidity: from 0% to 80%, noncondensing

Storage Requirements

Ambient temperature: from -20°C to 50°C

Relative humidity: from 0% to 90%, noncondensing

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Chapter 5. Component Descriptions

CCD Camera Head

There are two thermoelectrically cooled camera heads available with the Series 300 camera system. For additional information about your particular camera head (including its operation, maintenance, and cooling), see *Chapter 3. CEU and Camera Heads*. Camera head specifications can be found in *Chapter 7. Specifications*.

Each Photometrics camera head houses a CCD as well as electronics that are directly associated with CCD operation.

CCD

When you order a Series 300 camera, you choose from a range of CCDs that differ in size and grade. All Series 300 CCDs are scientific-grade, grades with fewer defects than commercial grades. Scientific-grade CCDs image with better resolution, have low noise so they can detect weak signals, and are linear over the dynamic range so you can accurately judge intensity differences between objects.

Dark Charge Reduction Modes

All Series 300 cameras have either Multi-Pinned Phase (MPP) or Advanced Inverted Mode Operation (AIMO) CCDs. These CCDs are built to have less thermally generated noise for a given exposure time, a property useful when trying to detect weak signals.

Metachrome® II

Metachrome II is a proprietary, optional, permanent CCD coating that is available on all Series 300 CCDs. This coating extends the CCD's sensitivity to below 200 nm and is transparent from 400 to 1100 nm wavelength light. The coating requires no maintenance and does not degrade over time.

Certificate of Performance

Each Series 300 camera has a Certificate of Performance. This certificate states the CCD grade that has been designated by the CCD manufacturer. The certificate also provides the camera performance information needed to effectively measure photon flux with repeatable, scientific accuracy. A copy of the information contained in the Performance Certificate is kept on file at Roper Scientific Customer Service.

CCD Chamber

The vacuum-sealed CCD chamber protects the CCD from contamination as well as insulating it from the warmer air in the camera body. The low humidity also reduces the chance of condensation forming on the CCD when the temperature is lowered. If any gasses are trapped in the vacuum chamber, they are absorbed by a sieve located inside the chamber.

The vacuum also isolates the window from the cooled CCD. This thermal barrier keeps the window from cooling below the dew point, thereby preventing condensation on the window.

Window

The camera has one window in the optical path. The CCD does not have a window. Compared to a multiple-window design, a single window reduces the chance of image degradation due to multiple reflections, stray light, and interference patterns.

The standard Photometrics window is made of fused silica (quartz) with a broadband antireflective coating. Fused silica has better ultraviolet transmission than crown glass. The antireflective coating increases the light transmitted through the window from 92% to 99%, further decreasing light loss.

Optional infrared-blocking (IR) windows are available. The IR window blocks optical radiation above 650 nm, providing a sharper image.

Thermoelectric Cooler

While the CCD accumulates charge, thermal activity releases electrons, generating dark current. Cooling the CCD helps enhance the low-light sensitivity by reducing the thermally generated charge. Cooled CCD cameras produce less dark current than cameras operating at ambient temperature.

The CCD is cooled by a Peltier cooler, a thermoelectric cooler (TEC) that pulls heat away from the CCD and into a heat exchanger. The heat exchanger transfers the heat into the camera body, where it is passively radiated to the environment or is sunk into liquid coolant in liquid-cooled camera heads.

Shutter

The camera has a high-speed shutter. The shutter is a mechanical component that has a limited life with heavy use. Instructions for testing and replacing the shutter are in *Chapter 6. Troubleshooting*.

Lenses

Photometrics sells lenses that are compatible with the F-mount and C-mount camera heads. The F-mount camera heads are compatible with any lens that fits a standard Nikon bayonet mount. The C-mount camera heads are compatible with any lens that fits a standard threaded video mount.

A C-mount lens with optics that protrude a long distance into the camera may interfere with the shutter blades. For specifications for calculating acceptable flange focal distances, see *Chapter 7. Specifications*.

Camera Electronics Unit

Operation of the CEU, which houses signal processing, camera control, and temperature control systems, is discussed in *Chapter 3. CEU and Camera Heads*. Information on the CEU's displays and power supply can also be found in *Chapter 3.*

Electronics

The electronics control the CCD and convert the CCD's analog signal into a digital format acceptable to the system's interface hardware. Low-noise electronics reduce signal degradation, while thermoelectric cooling of the camera head enhances low-light sensitivity by reducing dark current.

There are no user-serviceable parts inside the CEU. *Do not remove the CEU's cover.*

One of the printed circuit cards in the CEU is the analog processor card. There are four analog processor card options:

- 16 Bit/40 kHz
- 16 Bit/200 kHz
- 14 Bit/200 kHz
- 12 Bit/500 kHz

The analog processor card option that you have selected is installed in your CEU. All of the options offer low noise and high dynamic range. The choice is governed by your application and the tradeoff between speed and dynamic range.

Every camera is tested to guarantee that the response is linear over the entire dynamic range.

Connectors Several connectors are located on the back panel of the CEU. (For an illustration of the unit's back panel, see page 7.)

I/O Status The Input/Output Status is a 9-pin connector that gives access to a filtered trigger input, trigger input configuration, and camera status outputs. Pinout specifications are located in *Input/Output Status Connector Pinout* on page 41.

Shutter Status Shutter Status is a BNC connector that gives access to an output signal that indicates if the shutter is open or in motion. For specifications on this connector see *Shutter Status Connector* on page 42.

Trigger Trigger is a BNC connector that gives access to an unfiltered, fast response trigger. A trigger input allows you to synchronize the camera trigger signal with external equipment. The signal provided into this input must be clean, or you may get false triggers. For information on a filtered trigger input, see I/O Status (below). For specifications on this connector, see *Trigger Connector* on page 42.

AIA Controller Digital data is transmitted through the AIA connector. The AIA connector is a 68-pin, high-density, I/O connector with a standard AIA format. The pinout for the data cable that mates to the AIA port connector is located in *Data Cable Pinout* on page 44.

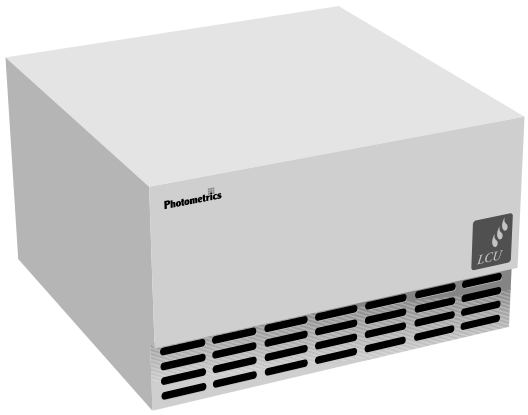
Camera The Camera connector is a DB37 connector for the camera head cable. Analog data from the camera head is transmitted through this port for digital conversion and processing inside the CEU.

Shutter Shutter is a modular phone jack that allows the CEU to control the shutter. For specifications, see *Shutter Connector* on page 43.

Shutter Control Shutter Control is a subminiature phone jack that allows you to operate the shutter directly. For specifications, see *Shutter Control Connector* on page 42.

Liquid Circulation Unit

The LCU is required for the liquid-cooled Series 300 camera head. The LCU cools the CCD by pumping a mixture of ethylene glycol and distilled water through the camera's heat exchanger. For LCU specifications, see *Liquid Circulation Unit* on page 40. Information on operating the liquid circulation unit can be found in *Chapter 4.*



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Chapter 6. Troubleshooting

If you have any difficulty while troubleshooting, or do not see your camera system's symptoms listed here, contact Roper Scientific Customer Service.

The following issues have corresponding troubleshooting sections in this chapter.

Caution: Connecting or removing a live cable to or from the camera system can damage the camera's electronic components. Do not attach or remove any cables while the power supply is turned on.

Camera System Startup Problems	page 28
System Does Not Boot Normally	page 28
New Hardware Found Dialog Box Does Not Appear (Windows 98SE/2000/ME/XP)	page 28
Images Not Displayed Properly	page 29
Camera Does Not Respond to Light	page 29
Camera Does Not Focus	page 29
CH350/L Not Cooling	page 29
PVCAM Error Message Appears	page 29
Lengthy Pauses During Imaging	page 29
Green Light on CEU Remains Illuminated	page 30
Testing Shutter Signal	page 30
Changing LCU Line Entry Module Fuses and Voltage	page 31
Changing a Fuse in the CEU	page 33

Camera System Startup Problems

The system components are complex instruments: take care when tracking down a problem. Most startup problems can be traced to a loose cable or a loose card. A component failure is more likely if the system has not been disconnected and fails after operating correctly for a time.

Problems with the host computer system or software may have side effects that appear to be hardware problems. If you are sure the problem is in the camera system hardware, begin with these simple checks:

- Turn off all AC power.
- Check that all cables are securely fastened and that all screwlocks are in place.
- Check the CEU for a burned-out fuse. Fuses are located in the fuse compartment on the back panel. For information about changing a fuse in the CEU, see *Changing a Fuse in the CEU* on page 33.
- If you have an LCU, check its cables and fuse. The fuse is located in the fuse compartment on the back panel. For information about changing a fuse in the LCU, see *Changing LCU Line Entry Module Fuses and Voltages* on page 31.
- Correct any apparent problems and try the system again. If the system still does not operate, contact Roper Scientific Customer Service.

System Does Not Boot Normally

If your operating system does not boot normally after you have installed a PCI card, try installing the new card in another open PCI slot. If this does not work:

1. *Turn off your computer* and remove the newly installed PCI card.
2. Turn your computer back on. If your system boots normally, there is probably an interrupt conflict between a previously installed expansion card and the PCI card that you are installing.
3. If you need assistance resolving the interrupt conflict, contact Roper Scientific Customer Service.

New Hardware Found Dialog Box Does Not Appear (Windows 98SE/2000/ME/XP)

If the New Hardware Found dialog box does not appear after installing a new PCI card to your computer and booting Windows 98SE/2000/ME/XP:

- Check to make sure that the new PCI card is inserted in a PCI slot according to your computer manufacturer's instructions and that the Series 300 system's CD-ROM is in the host computer's CD drive.
- It is possible that there is a conflict between the new PCI card and a previously installed expansion card. *With the computer's power turned off,* remove any previously installed expansion cards that your system does not need to function. (If you are unsure which cards can be safely removed, call Roper Scientific Customer Service.) Then turn your computer back on and boot Windows 98SE/2000/ME/XP again.

If the New Hardware Found dialog box still does not appear, contact Roper Scientific Customer Service.

Images Not Displayed Properly

If no images appear:

- Confirm that the red LED on the back of the camera is illuminated, indicating that the camera is powered on.
- Confirm that the correct Series 300 camera is selected in your imaging software application.
- Power off the camera and the host computer and check all system connections (particularly both ends of the Series 300 data cable). Restart. If no images appear:
  - Confirm that Windows is set for at least 16-bit colors.
  - Confirm that the camera is operational by taking an image with a standard lens attached to your Series 300.

  Using normal room lighting, place the camera on a table about 3 meters away from an object and acquire an image using your system's Brightfield settings.

If the problem persists, contact Roper Scientific Customer Service.

Camera Does Not Respond to Light

If your camera has no response to light, a faulty camera shutter may be causing the problem. See *Testing Shutter Signal* on page 30.

Camera Does Not Focus

For RS Image, with a standard lens attached to the camera, click the Focus button on the toolbar while adjusting the lens. For other imaging software see the focusing instructions in your imaging software documentation. With a C-mount camera, it may be necessary to install optical shims to focus the camera. Slowly unscrew the camera from the C-mount device to see if shims will improve the focus.

CH350/L Not Cooling

If after 15 minutes of operation the green light on the CEU is still illuminated:

- Check to see if coolant is moving through the unit.
- If the coolant becomes clouded with many tiny bubbles, your coolant level may be low. Fill the coolant reservoir. See *Refilling the Reservoir* on page 19. If bubbles persist, *see Removing Air Bubbles* on page 21.
- Check the hose and power cord connections.
- Check the LCU line entry module fuse. For instructions on accessing and changing the fuse, see *Changing LCU Line Entry Module Fuses and Voltages* on page 31.

If the camera still does not cool, call Roper Scientific Customer Service.

PVCAM Error Message Appears

If a PVCAM error message appears, note the message's number code and contact Roper Scientific Customer Service.

Lengthy Pauses During Imaging

If you notice lengthy pauses marked by a lot of disk activity while imaging:

- Close any other programs that may be running.
- Install more physical memory to your computer system.

Green Light on CEU Remains Illuminated

If the green COOLING light on the CEU remains illuminated after 15 minutes of continuous operation for a thermoelectrically cooled camera head, see the guidelines in the appropriate camera head section of *Chapter 3. CEU and Camera Heads*.

Testing Shutter Signal

To test for a malfunctioning shutter:

1. Turn on the power to the camera.
2. As the camera is powering up:
   - If you hear 2 clicks separated by 1 second (shutter opening then closing), the shutter is working. Call Roper Scientific Customer Service for further instructions.
   - If you hear 0, 1, or more than 2 clicks, check the voltage between I/O port pins 3 (exposing) and 9 (ground) while you are powering up the camera. (See *Input/Output Status Connector Pinout* on page 41.)

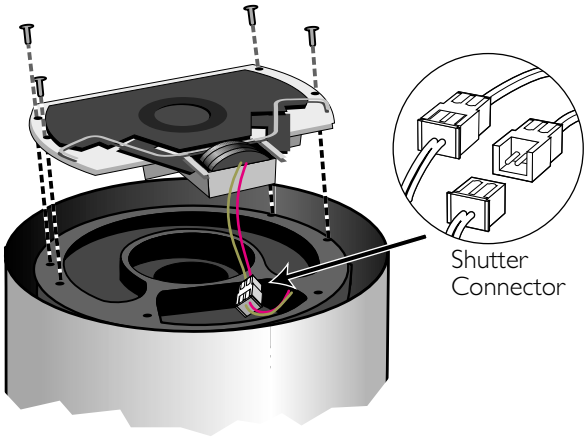
   If the TTL logic level goes from 0 (low) to 1 (high), stays high for 1 second then drops to 0, the shutter signal is working, but the mechanical shutter is not working. Follow the procedure in *Replacing Camera Shutter*, starting below.

If the TTL logic levels do not indicate a working shutter signal, call Roper Scientific Customer Service.

Replacing Camera Shutter

Caution: The camera's window will be exposed during the shutter replacement procedure. Take care to protect the window from dust, smudges, and damage. Replacing the shutter does not require opening the camera head. Opening the camera head will void the camera warranty.

1. To access the shutter:
   - Use a 3/32" hex wrench to remove the three #4-40 socket head screws that hold the faceplate (on C-mount cameras) or the lens mount (on F-mount cameras) to the camera head.
   - Remove the faceplate/lens mount from the camera head.
2. To remove old shutter:



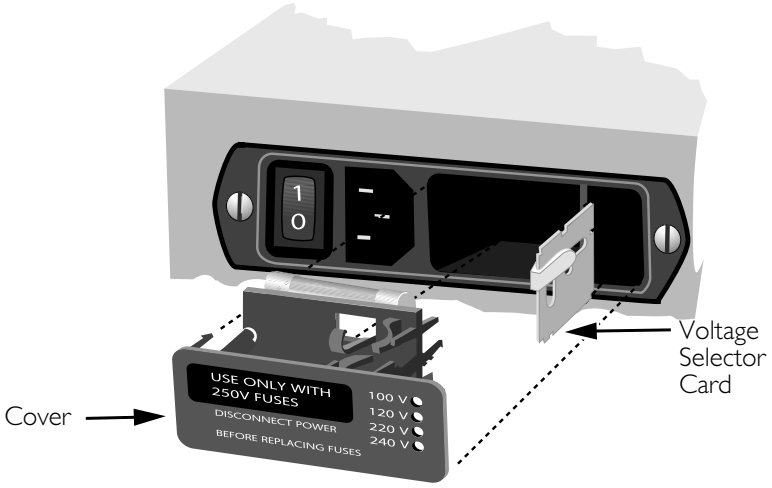
- Remove the three (or four) #2-56 screws holding the shutter in place. Note the position of the washers that you remove and take care not to lose them.
- Lift the shutter and note the position of the shutter connector in the well below the shutter.
- Disconnect the shutter connector.
- Discard the shutter.

3. To replace shutter:
   - Connect the new shutter connector.
   - Place the connector in the well below the shutter in its original position, making sure that the connector does not interfere with shutter operation when the shutter is completely open.
   - Check that the shutter cable does not interfere with any of the shutter's moving parts.
   - Fasten down the new shutter with the three (or four) #2-56 screws. Ensure that the washers are placed in their original positions.
4. To reassemble the camera:
   - Fasten faceplate/lens mount in place with three #4-40 screws.

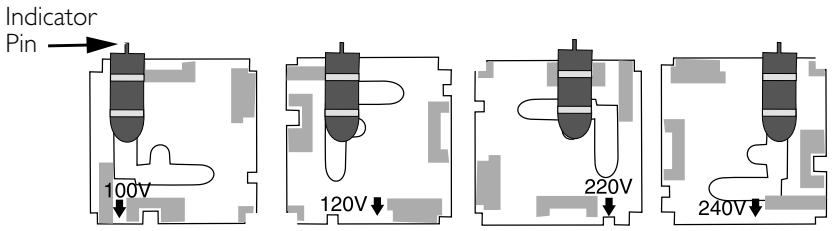
Changing LCU Line Entry Module Fuses and Voltage

The voltage selector card and fuse configuration on the AC line entry module are set to the correct voltage for your country. If your voltage source changes, you will need to change the voltage selector card, and you may need to change the fuse configuration.

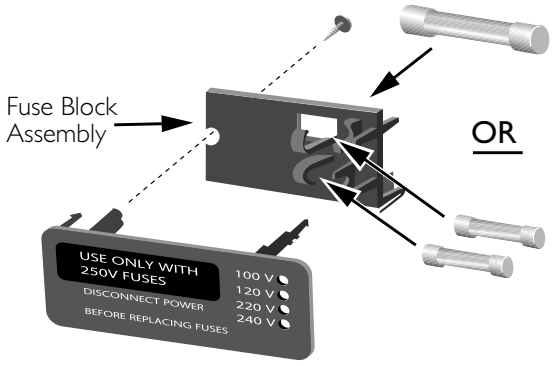
To change voltage and fuse configuration:



1. With the LCU powered off (Off = 0), remove cover by prying off with a tool such as a small blade screwdriver.
2. Using a tool such as a needle nose pliers, pull voltage selector card straight out.

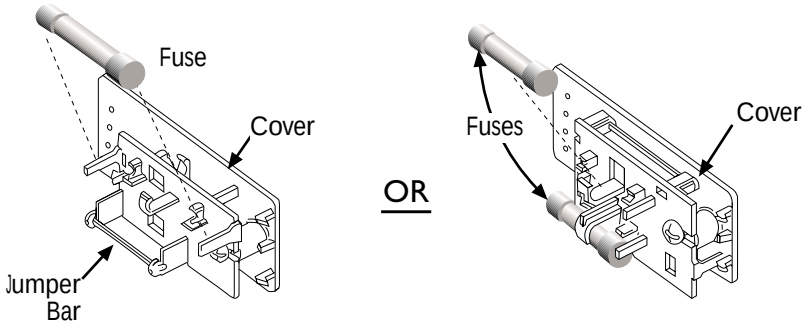


3. Position the indicator pin so it is pointing up while the arrow associated with the correct voltage points down.
4. With the indicator pin facing out and the printed side facing the powercord socket, replace the voltage selector card.



5. Remove screw and slide fuse block assembly from cover.
6. Insert one or two fuses:

Volts	# of Fuses	Amperes
110-120V	1	2A
220-240V	2	1A



7. Making sure that the fuse or fuses being used are facing away from the back of the cover (that is, toward the inside of the unit), replace the fuse block assembly.
8. Replace the cover and verify that the indicator pin is showing through the cover and marking the desired voltage.

Changing a Fuse in the CEU

The fuse compartment for the CEU is located on the unit's back panel (see the illustration on page 7). The directions for changing a fuse in the CEU are the same as for changing a fuse in the LCU. The directions for changing the fuse voltage and configuration are the same, as well.

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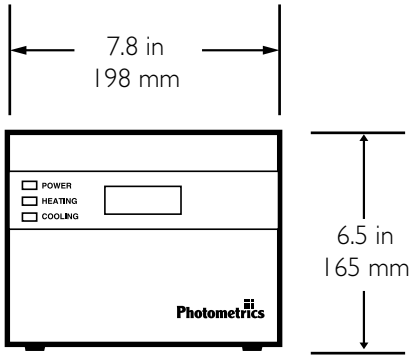
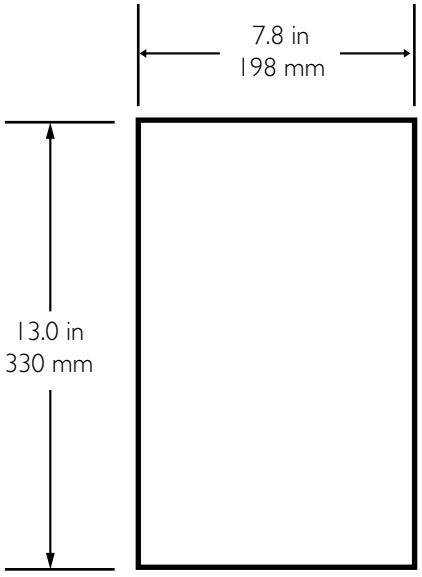
Chapter 7. Specifications

Camera Electronics Unit

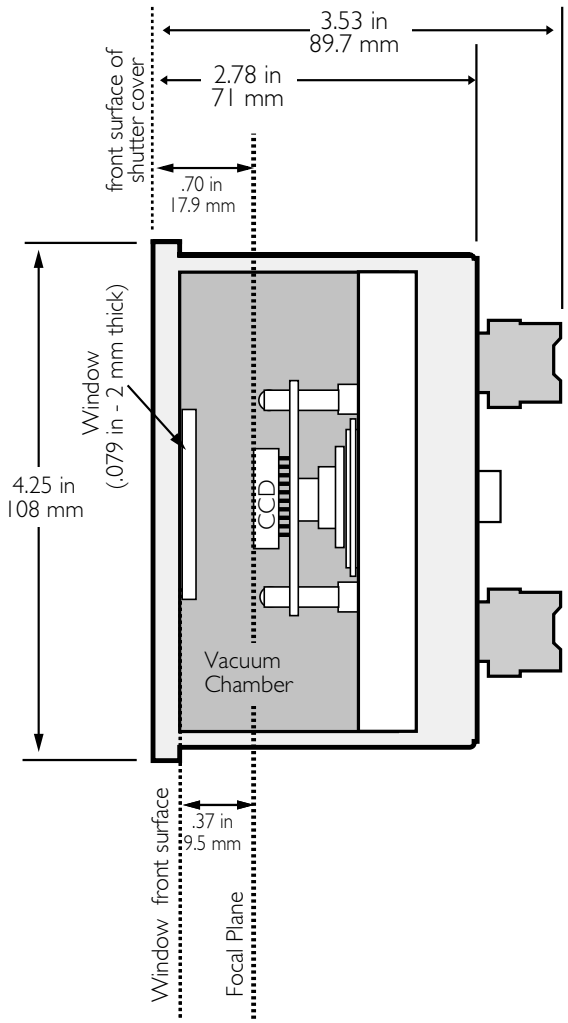


Front View

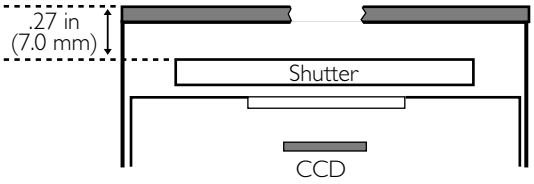


Top View

C-Mount CH350/L CCD Camera Head

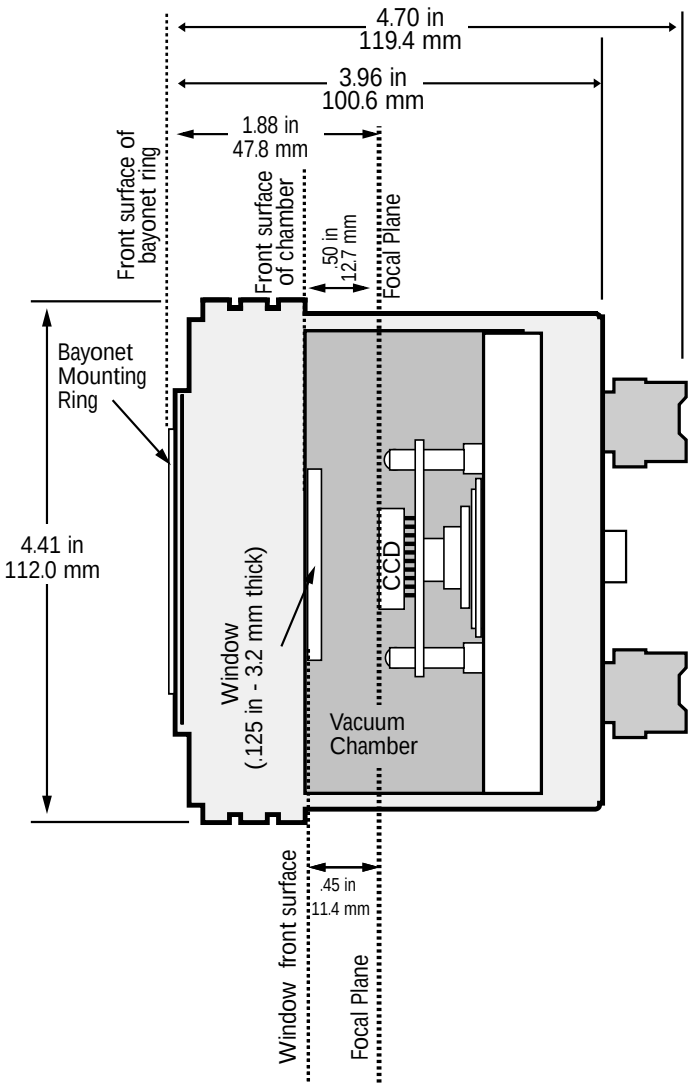


Cut Away View



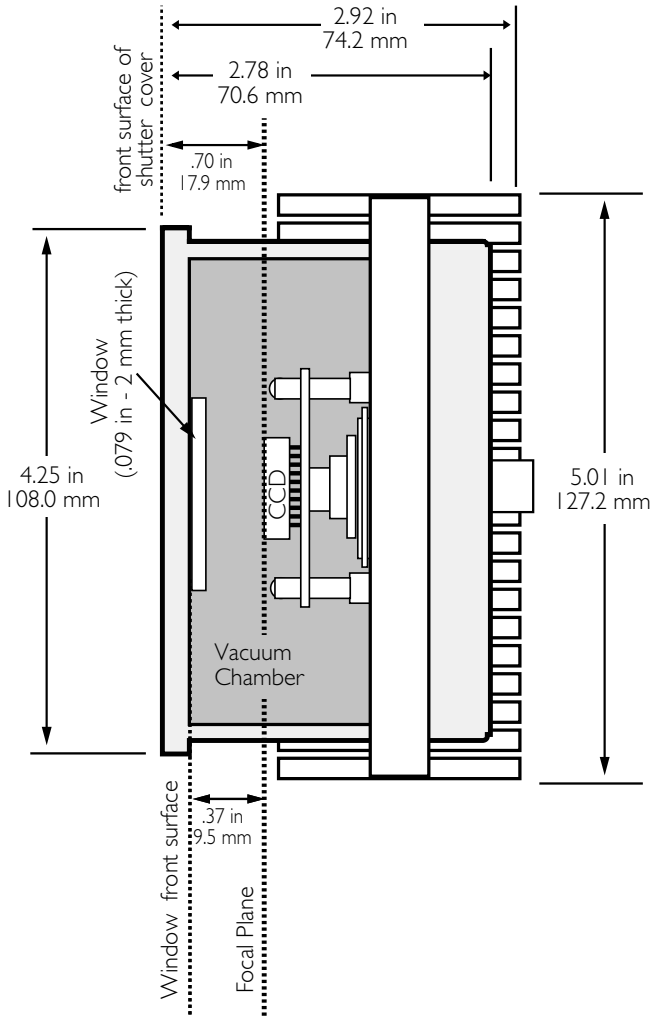
Shutter Distance View

F-Mount CH350/L CCD Camera Head

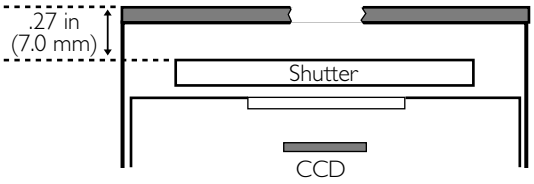


Cut Away View

C-Mount CH350/A CCD Camera Head

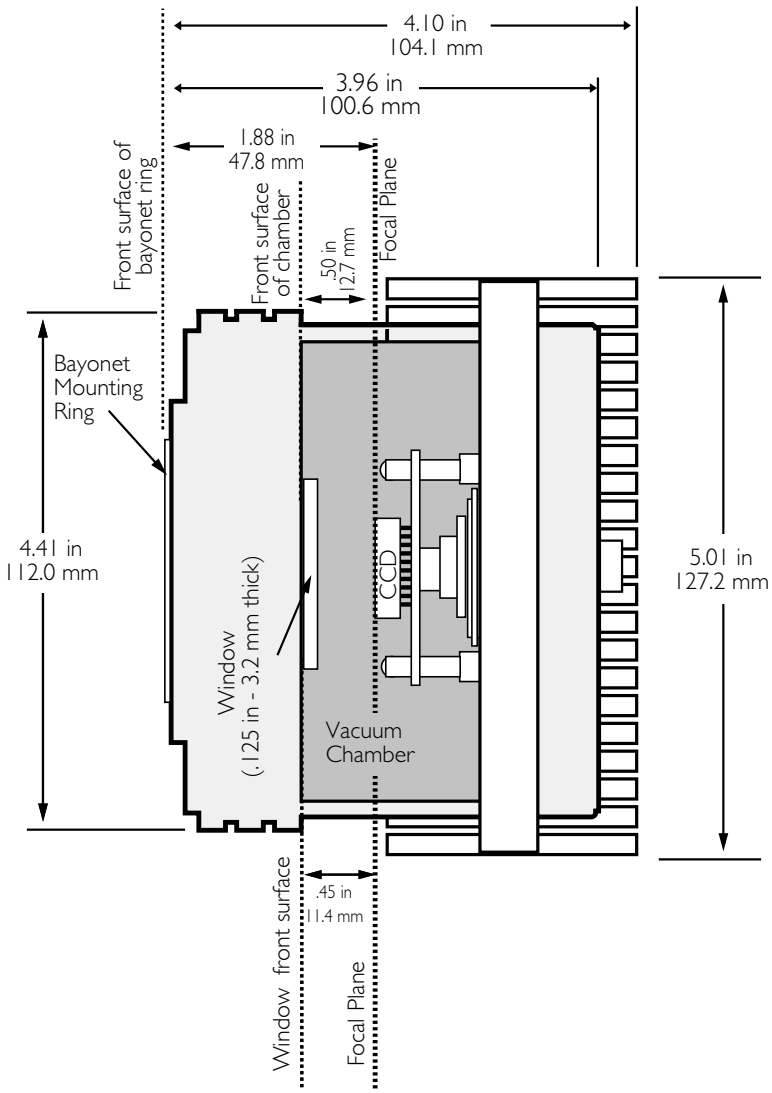


Cut Away View



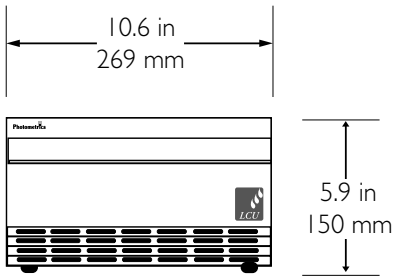
Shutter Distance Diagram

F-Mount CH350/A CCD Camera Head

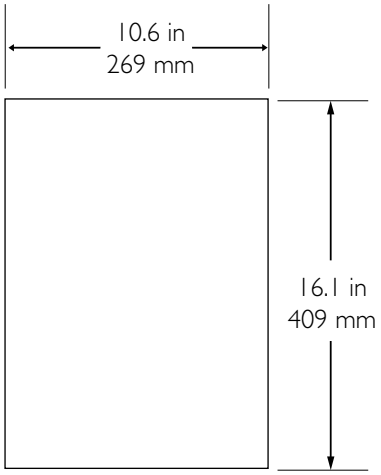


Cut Away View

Liquid Circulation Unit



Front View

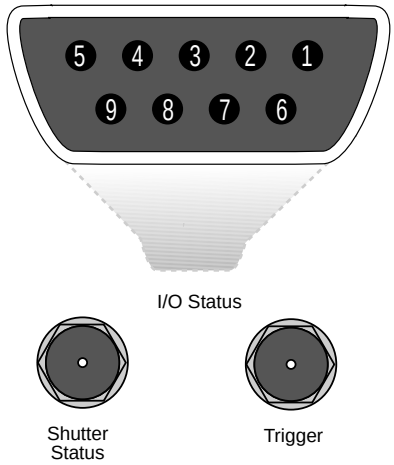


Top View

Characteristic	Specification
Liquid Coolant Capacity	27 fluid ounces (800 cc)
Required Coolant Mixture	30% DOWTHERM SR-1 and 70% de-ionized water (supplied by Roper Scientific)
Flow Rate (approx.)	6 gal/hr (0.38 liters/min)
Weight	27 lbs (12.3 kg)
Voltage Input	100-240 V AC at 50-60 Hz
Power Draw	96 W

Connector/Cable Pinouts

The **Input/Output** Status, Trigger, and Shutter Status connectors (located on the back panel of the CEU) provide information about trigger function and shutter status.



Input/Output Status Connector Pinout

All inputs are pulled up to +5V through 10k ohm resistors. Outputs are driven by a 74HCT244 driver. Inputs must be at least 3.15V for a high and less than 0.9V for a low.

The numbers on the trigger connector diagram correspond to the numbers given to the definition of each of the pins. The I/O connector is a female, D-subminiature 9-pin connector.

1 WAIT FOR TRIGGER OUTPUT
Active high. A high level on this output indicates that the camera is waiting for a trigger input.

2 SHUTTER MOVING OUTPUT
Active high. A high level on this output indicates that the shutter is opening or closing. The output is low when the shutter is completely open or completely closed. The length of time this signal is held high is specified in PVCAM or by the Shutter Open Delay and Shutter Close Delay functions in the software program.

3 CAMERA EXPOSING OUTPUT
Active high. A high level on this output indicates that the camera is exposing (integrating).

4 FLASH OUTPUT
This pin is an output that can be controlled in PVCAM with the `FLASH_MODE` constant.

5 FACTORY SETUP
This pin is reserved for factory setup.

6 FILTERED TRIGGER INPUT
This input has an RC filter inline to reduce noise on the trigger input. The input is pulled low to initiate a trigger (default). If nothing is connected to the input, it is pulled high to prevent the system from getting false triggers.

To change the state of this input see TRIGGER INVERT INPUT (8). (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

7 TRIGGER INHIBIT INPUT
This input inhibits all trigger signals. If the input is pulled low, trigger activity is disabled. By default, the input is pulled high so the trigger circuitry is enabled. (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

8 TRIGGER INVERT INPUT
Active low. A low on this input inverts the state of FILTERED TRIGGER INPUT (6) and TRIGGER CONNECTOR (see below), causing a high level to cause a trigger. (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

9 GROUND
System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

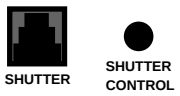
Trigger Connector

This input uses a TTL voltage level to trigger the camera. The input is pulled low to initiate a trigger (default). If nothing is connected to the input, it is pulled high to prevent the system from getting false triggers. To change the state of this input see TRIGGER INVERT INPUT (I/O Status 8). (The inputs are internally pulled up, so it is recommended to drive them with an open collector driver.)

Shutter Status Connector

Active low. A low level on this output indicates that the shutter is open or in motion. A high level output indicates that the shutter is closed or in motion.

Also located on the back panel of the CEU are the Shutter Control and Shutter connectors:

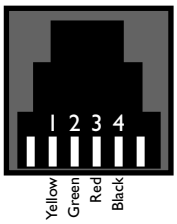


Shutter Control Connector

This subminiature phone jack allows you to operate the shutter directly. A simple switch can be connected to the center and outside pins of the jack. Closing the switch will open the shutter; opening the switch will close the shutter.

Shutter Connector

This modular phone jack connects to the shutter cable from a cryogenically cooled camera head. The thermoelectrically cooled camera heads include the shutter control functions in the camera head cable and therefore do not use the Shutter connector.



1 Flash (+)

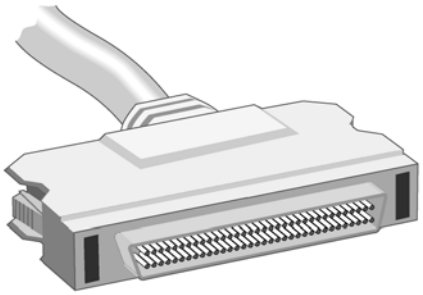
2 Shutter (-)

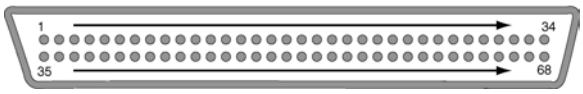
3 Flash (-)

4 Shutter (+)

Do not use these outputs to monitor shutter status. Use the Shutter Status connector on the CEU instead.

Data Cable Pinout





Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name
1	Ground	24	N/C	47	VD5-
2	Ground	25	FEN+	48	VD4-
3	Ground	26	LEN+	49	VD3-
4	Ground	27	N/C	50	VD2-
5	Ground	28	N/C	51	N/C
6	VD11+	29	PIX+	52	N/C
7	VD10+	30	N/C	53	VD1-
8	VD9+	31	N/C	54	VD0-
9	VD8+	32	N/C	55	N/C
10	VD7+	33	N/C	56	TX-
11	VD6+	34	Ground	57	RX-
12	Ground	35	Ground	58	N/C
13	VD5+	36	VCC	59	FEN-
14	VD4+	37	VCC	60	LEN-
15	VD3+	38	VCC	61	N/C
16	VD2+	39	VCC	62	N/C
17	N/C	40	VD11-	63	PIX-
18	N/C	41	VD10-	64	N/C
19	VD1+	42	VD9-	65	N/C
20	VD0+	43	VD8-	66	N/C
21	N/C	44	VD7-	67	N/C
22	TX+	45	VD6-	68	Ground
23	RX+	46	Ground		

Appendix A Trigger Modes

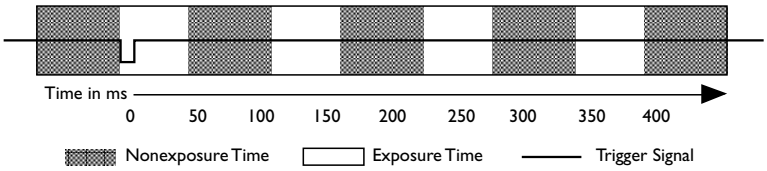
Series 300 offers several methods of integration with external trigger sources, such as delay generators or laser pretriggers. The camera has a 9-pin, D-subminiature connector on the back for trigger-in and various TTL input and output operations (see page 41 for the pinout specifications).

In the default mode, the camera triggers on the falling edge of a TTL signal. To invert the triggering polarity, the "Trigger Invert" must be grounded. The minimum trigger pulse width is 1.1 µsec.

The Series 300 camera supports the following trigger modes: Trigger-First, Strobe, and Bulb. These modes are described in the paragraphs that follow.

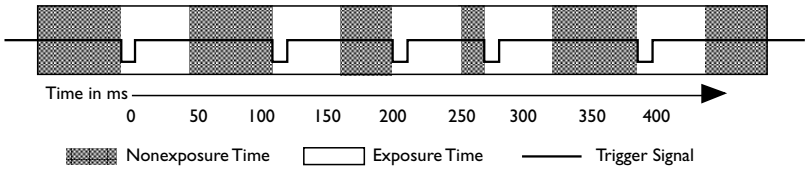
Trigger-First Mode

In this mode, the camera requires only one trigger to acquire a sequence of frames. Each frame is exposed for a length of time entered into the software and read out. Once the trigger is received, the camera is inhibited from taking any further triggers until the entire sequence is completed (see diagram below).



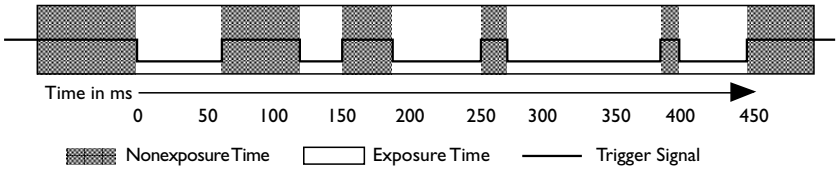
Strobe Mode

In this mode, each frame in a sequence requires a trigger. Each frame is exposed for a length of time entered into the software and is then read out. If the trigger arrives during the exposure-readout of the previous frame, it is ignored (see diagram below). For a sequence of one frame, strobe mode and trigger-first mode are the same.



Bulb Mode

In this mode, exposure time for each frame is determined by the trigger pulse width. Exposure time entered into the software is not used in this mode (see diagram below).



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57-055-001 Rev B2